

Acute lower respiratory tract infections in infants: the influence of central heating systems

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SUMMARY. A cohort of 342 infants in a group practice population were studied during the first year of life to assess whether hot-air central heating was associated with more severe respiratory infections than radiator central heating.

Infants born into council house families with ducted hot-air central heating were at no greater risk of contracting severe respiratory infections than those with radiator central heating. The risk of a respiratory infection was positively correlated with size of sibship and maternal smoking habits.

Introduction

SIX years ago a rumour developed on a new housing estate in Cardiff that the ducted hot-air central heating supplied by the Council was causing respiratory infections. Some people even demanded rehousing on these grounds, claiming that their children had more chest infections when living in the dry, hot air blown into their homes, and that those whose homes were heated by radiators were fitter.

The housing department had built hundreds of almost identical terraced homes which were heated by either ducted hot air or piped hot water from a central boiler house. These small, chimney-free houses were occupied by council tenants on a densely populated estate. This uniform high-density housing and dual heating system provided an unusual opportunity to study whether severe respiratory illness was more likely to occur in the council house children living in homes with ducted hot-air central heating. A positive result would justify a controlled trial of humidification or temperature control. A null conclusion would help clinicians and housing officers in the area to face parents who objected to

hot-air central heating on the grounds of their children's health.

Infants were studied because they are most exposed to the microenvironment of the home with its hazards of heat, smoke and cross-infection; lower respiratory infections were studied because an infant who experiences one is more likely to have chest problems later on (Colley *et al.*, 1973). Upper respiratory infections are of less long-term importance and are likely to be presented to the doctor for psychosocial as well as medical reasons.

Methods

All 389 children born into a health centre practice over a 36-month period were included in the study. Each of these children was followed prospectively for the first year of life. The birth record, health visitor's record and comprehensive primary care record were used to obtain socio-economic details and details of family size, birth weight, method of feeding, apgar score, perinatal risk factors and morbidity presented to general practitioners, nurse or hospital (Wallace and Davis, 1970; Stott and Davis, 1975).

A lower respiratory infection was defined as an acute infection in the lower respiratory tract, having chest signs on auscultation and, in the doctor's judgement, requiring an antibiotic. Thus the more serious infections were included and minor upper respiratory infections, tonsillitis and otitis media were excluded. Parental smoking histories were obtained by a short self-administered questionnaire; household heating systems were identified from the city engineer's map of the area. Maternal smoking was included in the analysis because the infant generally spends more time with its mother than any other person and is consequently more affected by her habits. A breast feeding question was added to the questionnaire for the final (12 months) cohort of infants to validate the results. All information was

Table 1. Infants with and without lower respiratory infection—by council or private housing and by sib number.

	Sibs = 0		Sibs = 1		Sibs = 2		Sibs = 3 +	
	Council	Private	Council	Private	Council	Private	Council	Private
With lower respiratory infection	3	12	40	9	28	4	15	1
Without lower respiratory infection	15	56	61	39	31	9	18	1

$\chi^2 = (86 - 77.66 - 0.5)^2 / 12.45 = 4.93, p < 0.95.$

Table 2. Infants with and without lower respiratory infection—by council and private housing and by maternal smoking.

	Non-smoker		0-4 cigarettes per day		5-14 cigarettes per day		15-24 cigarettes per day		25+ cigarettes per day	
	Council	Private	Council	Private	Council	Private	Council	Private	Council	Private
	With lower respiratory infection	37	14	3	3	12	5	29	4	5
Without lower respiratory infection	53	75	11	8	20	14	26	7	15	1

$\chi^2 = (86 - 71.93 - 0.5)^2 / 15.55 = 11.85, p < 0.001.$

extracted onto proformas and punched onto 80-column cards for analysis.

Results

Three hundred and eighty-nine children entered the study by birth into families registered with the study practice. Forty-seven children left the practice before the end of their first year, leaving 342 available for detailed analysis of acute lower respiratory illness. Two hundred and eleven families lived in council houses and 131 in private houses. Eighty-two council homes were heated by hot air and 129 by radiator. Private homes possessed a variety of individual heating systems, but none used ducted hot air.

One hundred and twelve children (32 per cent) were treated for one or more lower respiratory tract infection during the first year of life. Eighty-six of these lived in council houses. The hypothesis that hot-air central heating in council houses causes chest infections was not upheld as there was no significant difference between the number of infants who were infected when those born into hot-air and radiator-heated council homes were compared, nor was there any significant difference in the incidence of lower respiratory tract infection in the hot-air or radiator groups. The number of sibs, the social class of families, maternal smoking habits and breast feeding were similar in both council house groups. We did not analyse the results by doctor as it is highly improbable that selective diagnostic habits could have occurred within such closely matched council house groups. This does not apply to the private sector.

Although there was a positive association between number of sibs and the likelihood of infection in both council and private housing, overall the infants in private homes had fewer sibs and significantly fewer

infections than council house residents ($\chi^2 = 15.1, p < 0.001$). Further analysis of the differences between children in council and private housing (Table 1), adjusting for the number of sibs, left a significant council versus private difference ($\chi^2 = 4.93, p < 0.05$) and the difference persisted (Table 2) after adjusting for maternal smoking habits ($\chi^2 = 4.99, p < 0.05$). Correction for social class failed to abolish the council/private house difference for the number of infants experiencing one or more respiratory infections during the first year of life. Detailed data on breast feeding were available for the last 83 infants; this evidence suggested that breast feeding for one month or more protects against serious respiratory tract infection in the first year of life.

Validity of results

Any epidemiological analysis based on acute respiratory infection presenting to the doctor is bedevilled by bias introduced by variations in patient tolerance thresholds and diagnostic criteria. We attempted to overcome this by concentrating on the more severe illnesses with definite signs of lower respiratory infection. Furthermore, we also obtained agreement from general practitioners regarding minimal diagnostic criteria (Stott and Davis, 1975). Further validity of our results is suggested by our confirmation of the widely accepted association between the risk of acute respiratory infection and size of sibship (Table 1), breast feeding trends, maternal smoking habits, social class, and the private/council differences (Table 2). The relatively high incidence of acute respiratory illness in good housing conditions is compatible with the high population density per acre (Douglas and Bloomfield, 1958), and the number of young families involved. The rate (32 per cent) for infants with lower respiratory infections is a



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little higher than that reported in a survey by Grundy and Fanning (1957) in a sample of Cardiff and West Ham infants, but they included only pneumonia and bronchitis in their analysis.

Discussion

We could demonstrate no difference in serious respiratory morbidity between council house infants living in hot-air centrally heated homes and those living in radiator centrally heated homes. This was an important finding for the general practitioners facing anxious parents who had come to feel that hot air was harmful. Whereas the traditional scapegoat of 'damp weather causing chesty children' is safely outside personal control, this type of council house central heating is well within local control and the influence of pressure groups. It was with some relief that we came to a null conclusion over a politically sensitive issue, especially as the first year of life is regarded as a critical phase in respiratory development and risk (Douglas and Bloomfield, 1958; Dingle *et al.*, 1964; Colley *et al.*, 1974; Harlap and Davies, 1974; Watkins *et al.*, 1979).

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